Physics 8100 - Electromagnetic Theory I

Fall 2017 **N. Dietz**

Assignment # 5 (due to Monday, October 16, 2017)

1) **Jackson Problem 2.2** *(30 points)* (see textbook chapter 2): Consider the problem of a point charge q inside a hollow, grounded conducting sphere of inner radius a. Using the method of images, find

a) the potential inside the sphere;
b) the induced surface charge density;
c) the magnitude and direction of the force acting on q.
d) Is there any changes in the solution if the sphere is kept at a fixed potential V if the sphere has a total charge Q on its inner and outer surfaces?

2) **Jackson Problem 2.4** *(40 points)* (see textbook chapter 2): A point charge is placed a distance d > R from the center of an equally charged, isolated, conducting sphere of radius R.

a) Inside of what distance from the surface of the sphere is the point charge attracted rather than repelled by the charged sphere?
b) What is the limiting value of the force of attraction when the point charge is located at distance a (= d - R) from the surface of the sphere, if a << R?
c) What are the results of parts a and b if the charge on the sphere is twice (half) as large as the point charge, but still the same sign?

[Answers: (a) d/R-1= 0.6178; (b) $F=-q^2/(16\,\pi\,\varepsilon_o\,a^2)$, i.e. image force, (c) for Q=2q, d/R-1=0.4276; for Q = q/2, d/R-1=0.8823. The answers for part b is the same.]

3) *(30 points)* Using the method of images, (a) find the electric potential inside a grounded sphere due to a dipole at the center of the sphere, and (b) find the surface charge density on the sphere.